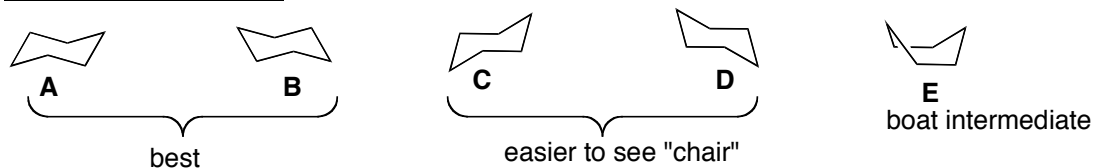


3.13 Cyclohexane Chair Conformations

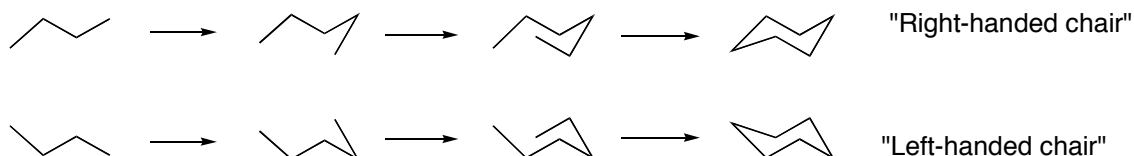
1. Cyclohexane has no angle strain or torsional strain
2. Cyclohexane has perfect 109° angles with staggered, non-eclipsed C-C bonds
3. Obviously it is not flat (natural angle for a flat cyclohexane would be 120°)

Chair Conformations:



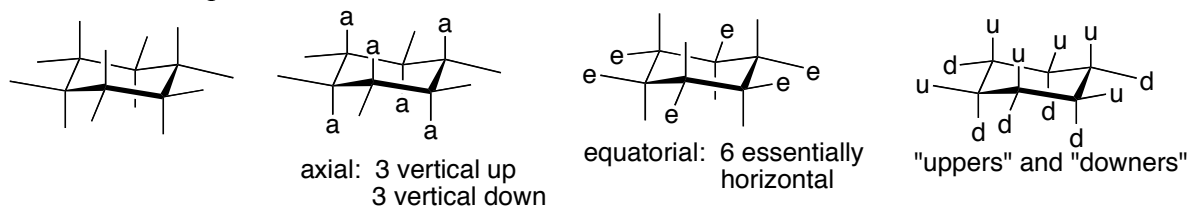
1. Chairs **A** and **B** are constantly interconverting via "boat" **E**
 - Online students: watch <https://www.youtube.com/watch?v=6VUUU-JExMs>
2. **A** and **B** are best to draw and work with.
3. But **C/D** make it easier to visualize why it's called a "chair": 4 carbons make the seat of the chair, one makes backrest, one a footrest.

Process for Drawing Both Chairs:



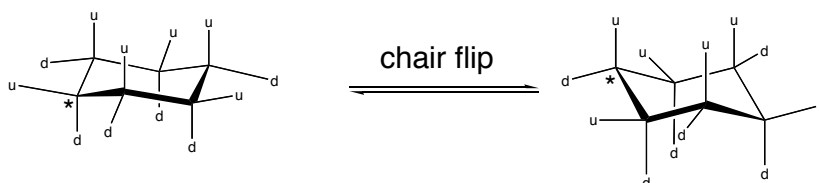
1. Draw a 4-carbon zig-zag. It helps if your left-most carbon is a little lower than your 3rd carbon
2. Add a 5th carbon and 6th carbon, but don't have them exactly underneath the 2nd and 3rd carbons.
3. Connect the 6th carbon to the original 1st carbon
 - For a "left-handed chair", start up and zig-zag down.

"Axial" and "Equatorial" Positions for Substituents



1. Each carbon has one axial and one equatorial H's
2. Always have six axial attachments
3. 3 axials up (on alternating carbons)
4. 3 axials down (on alternating carbons)

5. Always have six equatorial attachments
 6. For processing cis/trans problems, it's helpful to recognize "upper" from "downer" positions
 7. When a chair flips, what was equatorial becomes axial, and what was axial becomes equatorial
- Online students: (same one as last page) watch <https://www.youtube.com/watch?v=6VUU-JExMs>

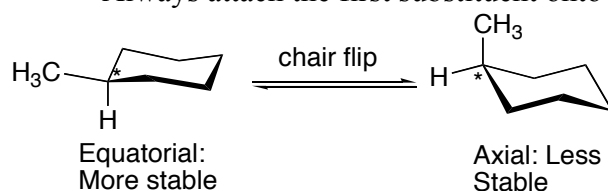


Drawing equatorial and axial bonds:

- Make axial straight up or straight down (3 each)
- Make equatorial bond lines almost exactly horizontal
- Equatorials are easiest to draw on left and right-most carbons

Drawing Mono- and DiSubstituted Cyclohexanes (Sections 3-14,15)

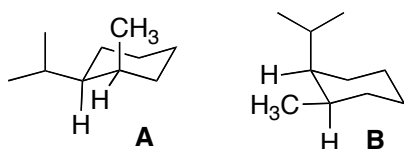
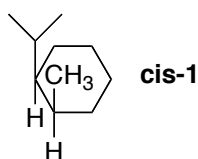
- Always attach the first substituent onto the leftmost carbon (easiest to draw)



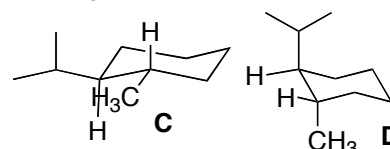
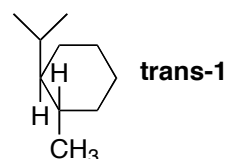
- Draw in the H on any substituted carbon, but skip on H-only carbons
- **Equatorial is better than axial for steric reasons.** In the axial configuration, the substituent has destabilizing steric interactions
 - Online students, watch: https://www.youtube.com/watch?annotation_id=annotation_2838862037&feature=iv&list=PLAhRiX8pHhMKI5fWwZQvZmBpPAv2LMVFQ&src_vid=6VUU-JExMs&v=R9VkdTjgd_w
 - 2 extra gauche interactions, and 1,3-diaxial interactions
- For disubstituted chairs, let the cis/trans relationship guide whether the second substituent should be in an "upper" or "lower" position relative to the original substituent.
- If one substituent is bigger than the other, the most stable chair will always have the larger substituent equatorial

Cis and Trans Disubstituted CyclohexanesQuestions:

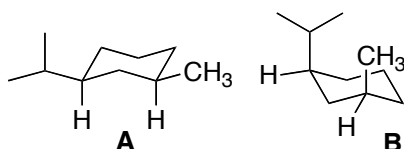
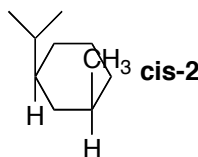
1. Draw both chair forms for cis-1-isopropyl-2-methylcyclohexane.
2. Which is the best chair for cis-1-isopropyl-2-methylcyclohexane?
3. Draw both chair forms and identify the best chair for trans-1-isopropyl-2-methylcyclohexane.
4. Which is more stable, cis- or trans-1-isopropyl-2-methylcyclohexane?
5. Then answer the same questions for the 1,3- and 1,4- isomers.

1,2-
DiSubbed

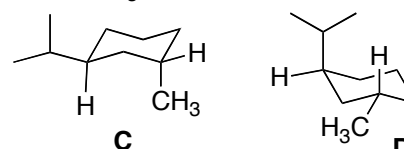
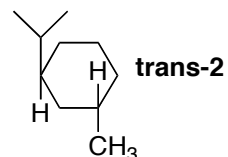
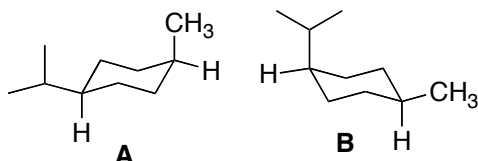
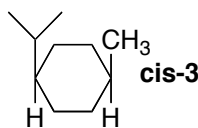
Best cis is **A > B**
 Best trans is **C > D**
 Best of all is **C (eq-eq)**, so trans-1 is better than cis-1



A > B and **C > D** because large isopropyl group wants to be equatorial

1,3-
DiSubbed

Best cis is **A (eq eq) > B (ax ax)**
 Best trans is **C (eq ax) > D (ax eq)**
 Best of all is **A (eq-eq)**, so cis-2 is better than trans-2

1,4-
DiSubbed

Best cis is **A (eq ax) > B (ax eq)**
 Best trans is **C (eq eq) > D (ax ax)**
 Best of all is **C (eq-eq)**, so trans-3 is better than cis-

